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Hardening of weld with metastable austenite structure by surface deformation

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Abstract. The study shows a technology comprising MIG deposition of cored wire like 50Cr18 with the subsequent surface deformation. Specially developed device realizes adjustable ball rolling load. The structure of the weld includes a large share of metastable austenite, which transforms to hard martensite at loading. The measuring shows that the technology provides an increase of the sample's surface hardness from 40 HRC to 54 HRC and decrease it's roughness from Ra 1,2 to Ra 0,4. The results allow using the technology applying to hydraulic pistons.

1. Introduction

One way to raise the component life of hydraulic rods and pistons is achieving required surface.

MIG deposition with the subsequent surface deformation by ball rolling [1] allows increase hardness and decrease roughness of the sample's surface.

The surface deformation is especially effective for steel including a large share of metastable austenite in structure, which transforms to hard martensite at loading. That process was shown as for solid steels [2, 3] and for deposited layers [4].

2. Experimental method

Cylinders ⌀40 mm from steel C30 were taken as template. Deposition was done in one and two layers by MIG welding power source «ШТОРМ LORCH S5», I = 102 A, U = 19 V, Impulse <P36>.

A cored wire of 50Cr18 type, ⌀ 1,2 mm, was taken as a feedstock.

The wire provides large share of metastable austenite in structure.

Besides, the weld is marked by advanced corrosive resistance due to high Cr content.

The character of the alloying system allows excluding components like Ni and Mn from the wire composition.

The weld is well machined with blade tool.

For the purpose of transforming the metastable austenite to the hard martensite structure on the sample's surface we have realized a surface deformation by steel ball rolling thanks to the single-ball tool, which had been specially developed and fabricated. The single-ball tool allows realizing surface deformation with adjustable loading from 0 to 200 kg, figure 1. The process of surface deformation was realized using lathe «1к62», V = 0,07 mm/rate, n = 60 rpm.

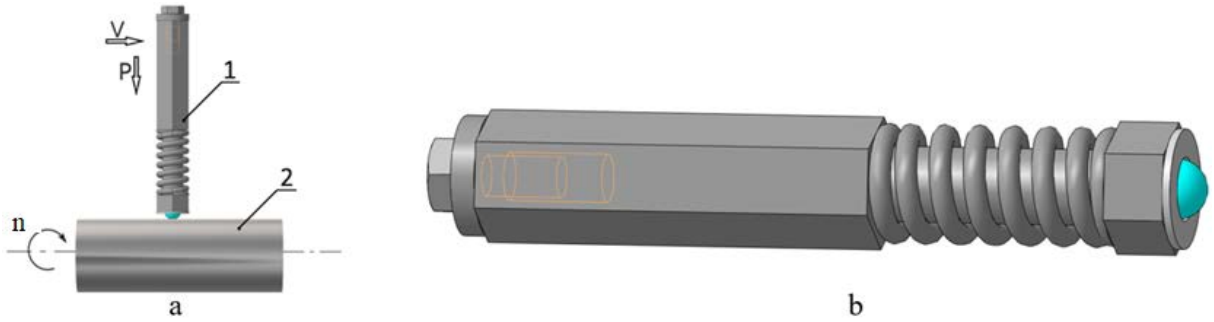

Figure 1. a – load scheme: 1 – single-ball tool; 2 – sample; b – single-ball tool, side view.

The samples were machined up to roughness Ra 1,2. Then the loads 150 and 200 kg were applied to their surfaces.

A hardness measurements were done using microhardness tester «ПМТ-3» and roughness measurement were done using surface analyzer «MarSurf M 300».

3. Results and discussion

The results of the measurements shows the following.

After the deformation the surface hardness raised, figure 2. We could also see the growth of hardening at increasing of layers and loading value.

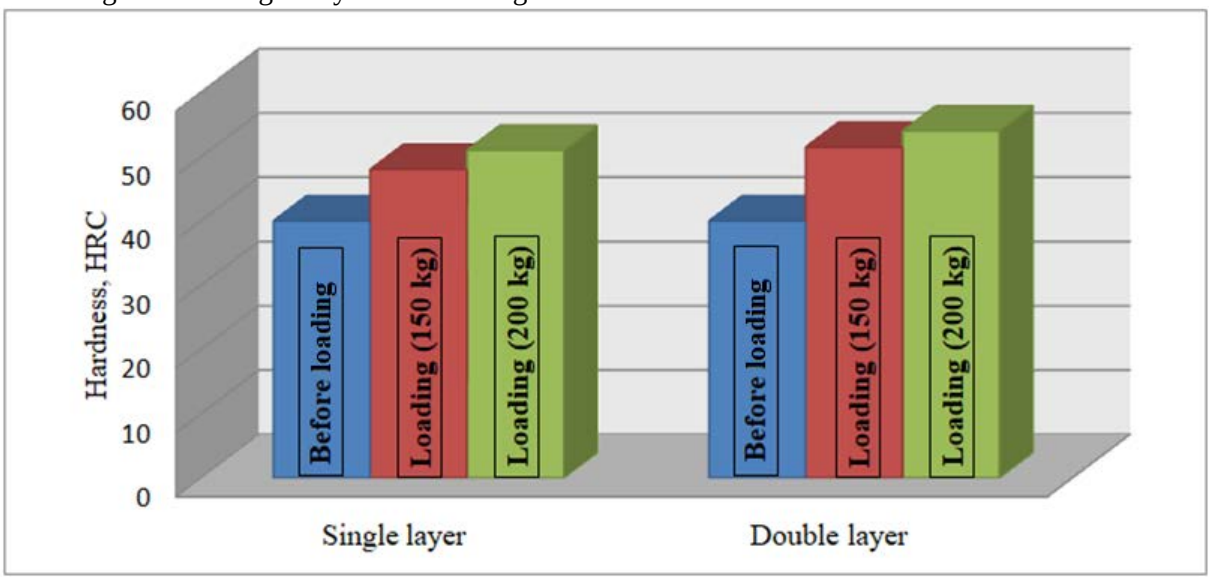

Figure 2. Hardness of the sample's surface depending on quantity of layers and loading value.

After surface deformation the roughness of sample's surface has improved comparing to unloaded samples. We could also see the 30% roughness decrease in case of double layer and 10% decrease at load increase, figure 3.

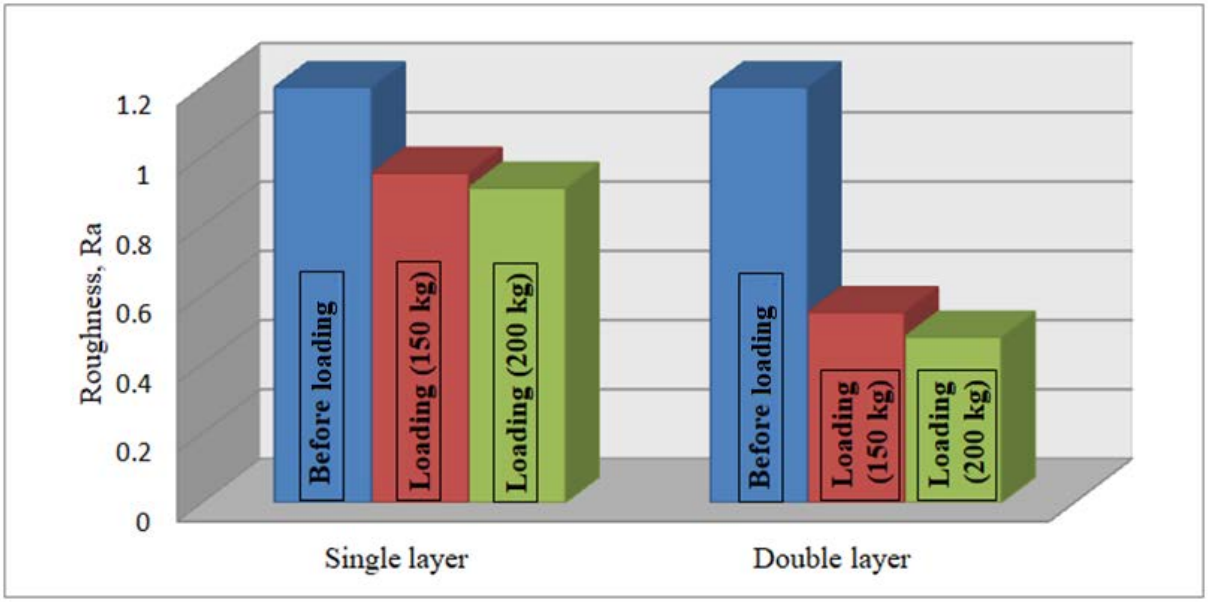

Figure 3. Roughness of the sample's surface depending on amount of layers and loading.

4. Conclusion

The study shows that MIG deposition of cored wire with the following surface deformation by single-ball tool provides an increase the surface hardness of the sample from 40 HRC to 54 HRC and decrease it's roughness from Ra 1.2 to Ra 0.4.

Proffered technology using the flux cored wire could be used for hardening and reconstructing of hydraulic rods and pistons.

The cored wire, which was used in the study, is industrially produced. For more information about supply of the wire and its application you could address to the authors of the study.

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